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FORECAST OF THE CHIGNIK SOCKEYE SALMON RUN IN 1967

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BACKGROUND

During the past eleven years Chignik sockeye salmon runs have ranged in size from 646,000 to 1,285,000 and averaged approximately 884,000 annually. The Fisheries Research Institute first began forecasting the magnitude of these runs in 1958 and was joined by the Alaska Department of Fish and Game in 1961 in an effort to consolidate the collection and evaluation of data. The method of forecasting is based on adult return analyses and nursery lake studies of the Chignik system.

FORECAST TECHNIQUE

Sockeye salmon runs returning to Chignik are composed of fish bound for two major spawning areas in the watershed. The total return is split into two segments based on our knowledge of time of entry: (1) the early run (through June 30) which is destined largely for the spawning tributaries of Black Lake and (2) the late run (after June 30) which is bound for the spawning areas of Chignik Lake (Figures 1 and 2).

The early run exhibits a significant ($r = 0.855$, d.f. = 8, $p < .01$) linear relationship between returns of .2 fish in one year and .3 fish the next year

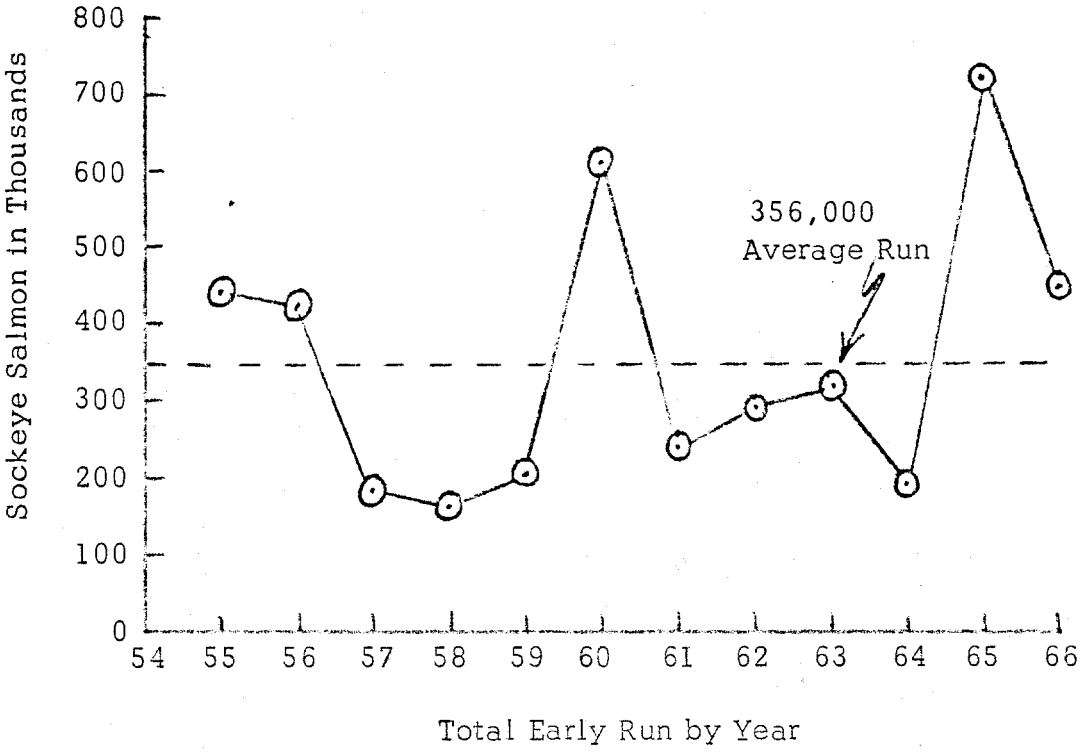

Figure 1. Total early run by year, 1955-1966.

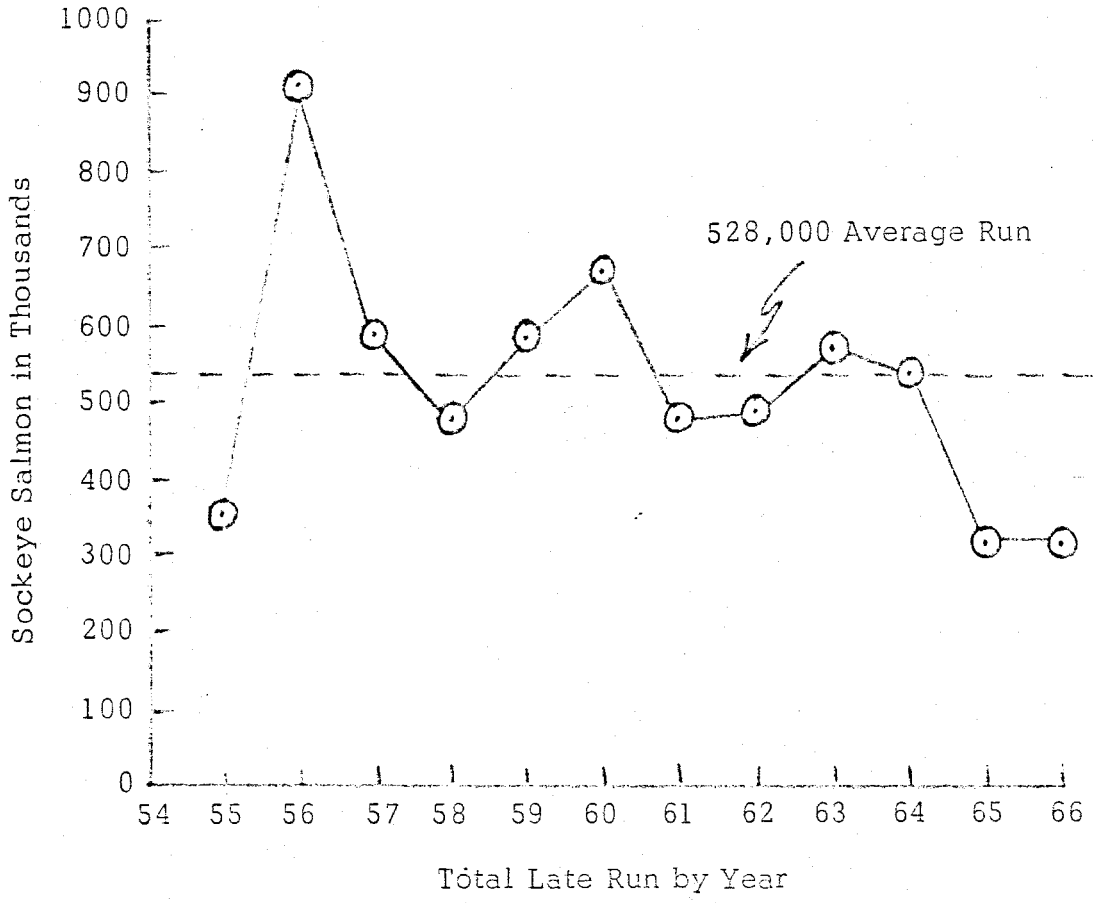

Figure 2. Total late run by year, 1955-1966.

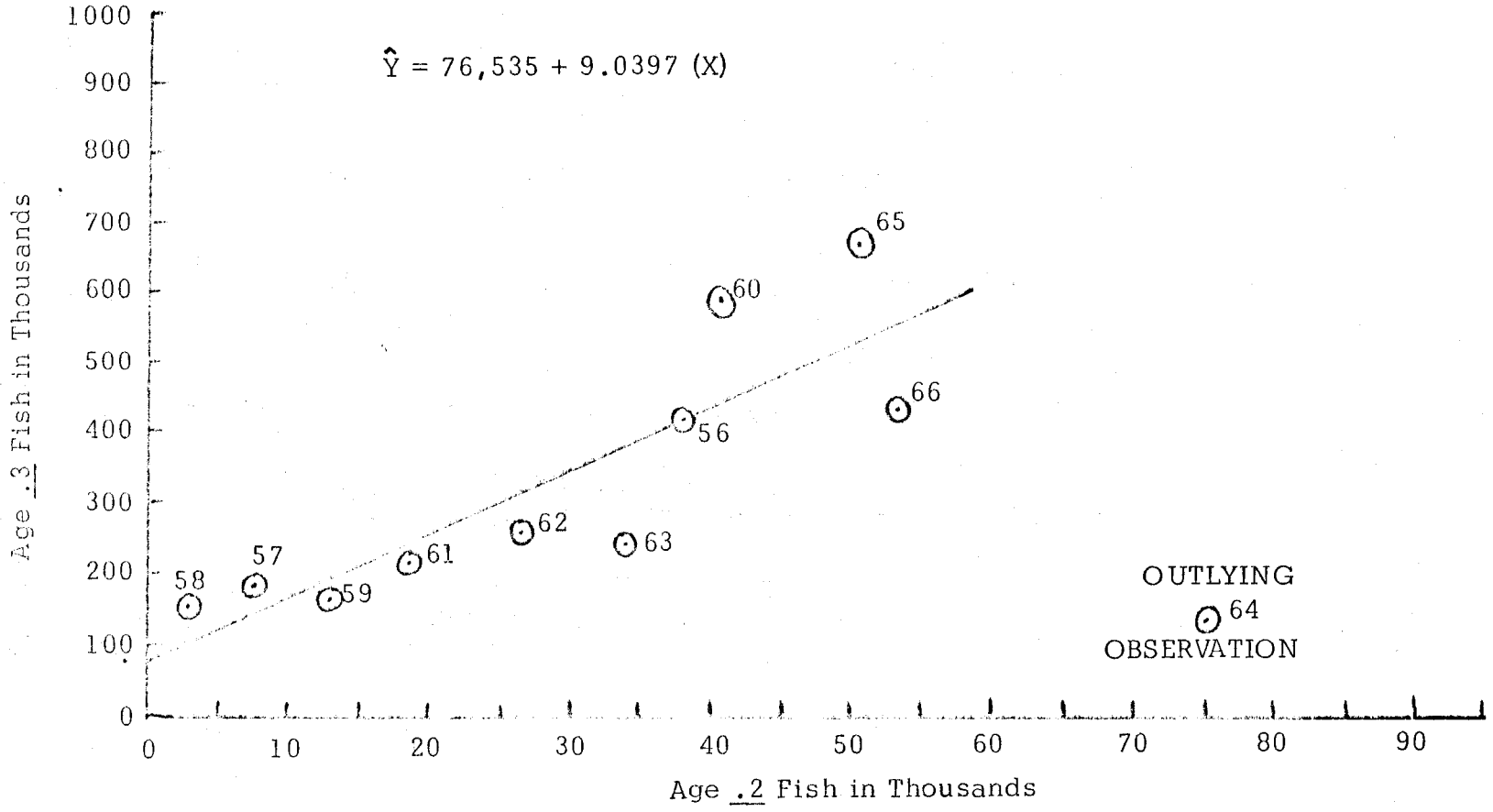

Figure 3. Regression of age .3 sockeye on age .2 sockeye of previous year for early run (prior June 30) 1956-1966.

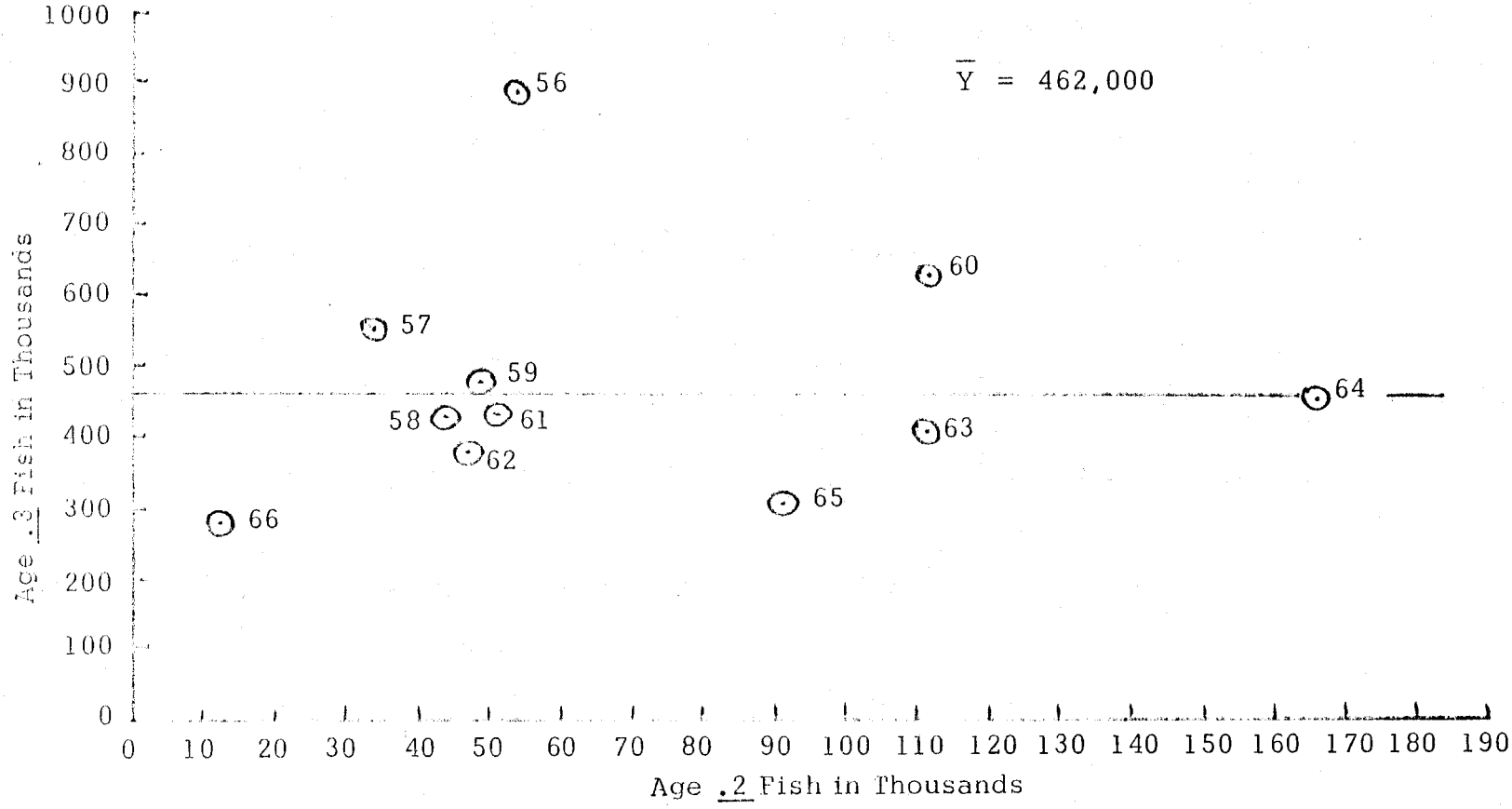

Figure 4. Regression of age .3 sockeye on age .2 sockeye of previous year for late run (after June 30) 1956-1966.

for each parent year class for which we have data (Figure 3). The outlying observation for 1964 is not considered in the analysis. The late run shows little or no relationship between .2 fish returning one year prior to the return of .3 fish of the same parent year class (Figure 4). Previous forecasts were made on the basis of the linear trend for the early run and the average return for the late run (Table 1).

Table 1. Chignik forecasts, 1958-1966

Year	Predicted Return	Actual Return	Per cent Relative Error
1958	621,000	646,000	- 3.9
1959	834,000	827,000	- 0.8
1960	1,900,000	1,285,000	+ 47.9
1961	795,000	721,000	+ 10.3
1962	940,000	801,000	+ 17.4
1963	1,348,000	906,000	+ 48.8
1964	1,340,000[1]	739,000	+ 81.3
1965	1,200,000	1,053,000	+ 14.0
1966	1,050,000	790,000	+ 32.9

[1] Qualified on basis of contradictory evidence from lake studies.

In 1964 we noted that the linear relationship of .2 fish return to .3 fish return one year later may be less reliable when large returns of .2 fish occur (Figure 3). Since 1964 analyses of young fish studies of the nursery lakes for the returning year class in question have been considered in forecasting of returns.

Adult Return Analyses

Table 2 presents the age composition data used in forecasting the magnitude of the 1967 return of sockeye salmon to the Chignik system.

Progeny of the 1962 year class will make up the early run in 1967.

The return of .2 fish during June, 1966, was the third smallest on record and indicates a poor return of .3 fish in 1967. Using the equation from regression of numbers of age .3 fish on numbers of age .2 fish the previous year ($\hat{Y} = 76,535 + 9.0397(X)$), the predicted early return for 1967 is 158,000 age .3 fish. In addition, we expect about 31,000 age .2 fish (the twelve-year average return for this age group) for a total run of 189,000 fish through the end of June.

The total late run (July 1 on) of all ages has been rather constant over the past eleven years (Figure 2). However, the late run in 1966 was little more than one-half the magnitude of the eleven year average run and analysis of the age composition of this poor return indicates another poor late run in 1967. Although there is no apparent linear relationship between the return of .2 fish and the return of .3 fish one year later for the late run (Figure 4), the late return of .2 fish during 1966 was the second lowest on record (24,000, compared with an average of 67,000 and a high of 166,000 in 1963). This suggests poor survival of the 1961 year class reared in Chignik Lake, whose progeny will make up most of the return of .3 fish in 1967.

Nursery Lake Studies

Ecological studies of the nursery lakes conducted at Chignik by the Fisheries Research Institute since 1960 give corroborating evidence for a poor return in 1967. Tow net catches of juvenile sockeye salmon in the two lakes during late August are shown in Table 3.

The mean catch per tow of sockeye salmon fry (returning as age 1.3 fish in June, 1967) in Black Lake during 1963 was approximately one-half the six-year average. This is consistent with the low parent escapement to Black Lake in 1962. Further, growth of sockeye salmon fry was suppressed by abundant competitor species in Black Lake during 1963. Examination of the relationship between mean catch per tow of Black Lake fry and resultant adult returns indicates an early run of about 265,000 fish. More confidence, however, must be placed in the estimate of 189,000 based on the relationship between numbers of .2 fish one year and .3 fish the following year for two reasons: the paucity of tow net data and the fact that the tow net and adult return relationship does not contain any estimate of the variable of marine survival. The relationship between .2 and .3 fish of the same year class, however, does account for survival in two of the three years that .3 fish spend at sea.

Table 2. Red salmon runs to the Chignik system, 1955-66
(No. of fish in thousands)

	Early			Late			
Year	.2	.3	Total	.2	.3	Total	Total Return
1955	37.8	403.2	441.0	54.2	300.3	354.5	795.5
1956	7.5	419.1	426.6	34.4	882.1	916.5	1,343.1
1957	2.6	183.0	185.6	44.0	550.3	594.3	779.9
1958	13.7	151.5	165.2	49.6	429.8	479.4	644.6
1959	40.7	165.6	206.3	112.4	475.0	587.4	793.7
1960	18.5	593.4	611.9	51.6	624.0	675.6	1,287.5
1961	26.7	211.6	238.3	47.1	430.6	477.7	716.0
1962	34.2	263.1	297.3	112.8	377.0	489.8	787.1
1963	75.1[1]	242.8	317.9	166.0	408.0	574.0	891.9
1964	50.6	146.0[1]	196.6	91.7	451.2	542.9	739.5
1965	53.6	674.2	727.8	13.7	306.1	319.8	1,047.6
1966	9.1	445.5	454.6	24.2	295.0	319.2	773.8
Averages	30.8	324.9	355.7	66.8	460.8	527.6	883.3

[1] Omitted from regression analysis.

The relationship between mean catch per tow of Chignik Lake fingerlings and adult returns indicates a late run of about 350,000 fish in 1967. Again, the small number of years for which we have adult returns corresponding to tow net catches places strong doubts on the preciseness of this estimate. It does, however, indicate a probable smaller than average late run in 1967.

Table 3. Tow net catches of sockeye salmon fry and fingerling[1]

Location	Year						Mean
	1961	1962	1963	1964	1965	1966	
Black Lake							
Fry	235	45	125	112	547	222	214
Fingerling	0	0	1	2	1	1	<1
Chignik Lake							
Fry	146	29[2]	105	138	55	78	104
Fingerling	70	102	90	40	52	19	62

[1] Expressed as mean catch per standard 5 minute tow, weighted by lake area.

[2] The entire Chignik Lake sockeye salmon fry population does not become pelagial until late summer. There is some evidence that the 1962 fry were exceptionally late in moving offshore and therefore not available to the tow net.

The forecast for the late run in 1967 is difficult to pinpoint because of the lack of a reliable quantitative method of predicting this segment. However, it should be a poor run, similar to the one in 1966. A conservative estimate for 1967 would be in the neighborhood of 350,000 fish, somewhere between the average late run of 528,000 and the lowest observed late run of 319,000.

SUMMARY

The total adult sockeye salmon return to Chignik in 1967 should be poorer than the past twelve year average of 884,000 fish, with both segments of the run being smaller than their respective averages.

Even though our studies indicate a poor return in 1967, there are three possible sources of error in the forecast. First, we have no measure of survival between the second and third years at sea, hence the return of age .3 fish may differ from what we expect in 1967. Second, there is an incidental harvest of sockeye salmon bound for Chignik at other places along the Alaska Peninsula. Analysis of tagging studies and catch records shows that the Stepovak Bay and Cape Kumlik fisheries take a portion of the Chignik run, especially the latter fishery. Finally, a lack of adequate scale samples from the 1966 early run may have affected the calculation of the number of .2 fish, with a resulting effect on the regression analysis for predicting the early run in 1967.

Summarizing, we expect the early run (through June 30) to be in the neighborhood of 189,000 fish and the late run (July 1 on) to be approximately 350,000 fish for a total 1967 return of around 539,000 sockeye salmon.